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it is doubtful whether air-humidity could be more than a rough guide.

If, as I suspect in this case, the oil on the arbours of the balance be hygroscopic, it is easy to see that it may become more fluid in damp weather, the arc of oscillation will increase, the balance vibration take longer, and the watch lose; but the momentary humidity of the air will not correspond to the rate as the temperature does more or less. Such a general accordance as I have shown seems the only possible result of comparison. But there seems in this case to me an undoubted connection, and it may be worth making special experiments in the following directions:

1st. Are chronometer oils, or any of them, hygroscopic?

2nd. Can they become so by exposure to a tropical climate? And in this last case I conceive that the climatic influence cannot be imitated in Europe. The effect of the heat, and probably the light, are very destructive of some materials. For instance, vulcanised indiarubber will not bear exposure in India, though it seems to answer in Europe even in heat and damp.

Lastly, in estimating the effect of humidity on a given chronometer, it will probably be best to use one of the old hair or grass hygroscopes for the humidity, placing it in the case enclosed with the watch.

P.S. As I shall be leaving India soon I shall not be in a position to investigate any farther with this watch.

H. M.'s Mint, Calcutta:
1883, *September* 14.

Showers of Large Meteors. The Muscids (*Oct.* 17–22) *and Herculids* (*Oct.* 17–26). By W. F. Denning.

A large meteor seen here on October 17, 1883, at $9^h 33^m$, as it traversed a nearly vertical path of 28° amongst the stars of *Hercules*, evidently belonged to a radiant point between *Aries* and *Taurus*, forming an early member of the prominent shower of Muscids (Oct. 25–Nov. 6), to which I called special attention in the *Monthly Notices*, vol. xlii. pp. 34–7. I had no idea, however, that this shower occurred with considerable brightness simultaneously with the Orionids, but on projecting the catalogued paths of a great many fireballs observed during the October meteoric epoch (Oct. 17–22) I found that the principal radiant lies at a very definite point S. of *Musca*, in the E. region of *Aries*, and close to the diverging focus of the later shower above referred to. In fact, this particular stream apparently gives many meteors of the finest class from about the middle of October

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to the end of the first week in November, and like its companion, though somewhat later, shower the Taurids, is of long continuance.

The following afford examples of these early and often brilliant Muscids:—

Year 1800+ and Date.			Mag.	Observed Path From		To		Length.	Observer.
				α	δ	α	δ		
49	Oct.	17	Fire-ball.	76°	+55°	188°	+41°	68	Heis, Aachen.
54		21	♀	72	+14	83	+12	11	Heis, Münster.
70		20	♃	10	+44	314	+53	38	Jadanza, Napoli.
70		22	♃	85	−11	90	−14	6	Maggi, Volpeglino.
72		19	♀	157·5	+71·3	183·3	+61·2	15	Holetschek, Wien.
77		20	♃	336	+22·5	293	+15·5	41	Denning, Bristol.
78		21	♀	5	−15	343	−32	27	Sawyer, Camb. U.S.A.
78		22	♃	3	−10	346	−28	25	,,
83		17	♀	259	+48·5	241·5	+24	28	Denning, Bristol.

Radiant point at 40° + 20°.

A careful search through all the published catalogues of observers would doubtless reveal many other brilliant meteors belonging to this system.

The shower seems to have been especially active in 1871. Prof. Herschel at Hawkhurst* saw six meteors (on Oct. 14, 11^h to 12^h), "as bright as or brighter than first mag. stars, radiating with considerable accuracy from a point near the head of *Aries*, and close to the point of first appearance on this date of the radiant R_3 in *Musca* which appears to contribute bright meteors from the direction of this constellation during the principal meteor-showers of October, November, and December, but from which so many bright meteors in one hour as those seen at Hawkhurst on the above date form an exceptional display. Another meteor like one noted on this date, as bright as *Sirius*, proceeded from the same radiant point, passing overhead at Hawkhurst, and leaving a faint streak at 11^h 45^m P.M. on Oct. 19, and two scarcely less brilliant members of the same meteor-shower appeared with short courses and slow motion near the radiant point on Oct. 21." The great meteor of Oct. 19, 1877, 6^h 13^m, may also have belonged to this stream, as the radiant point roughly inferred from a few uncertain observations was at 20° + 15°. The region of *Aries* is very rich in showers during October, and there is considerable difficulty in tracing their individual characters. In 1877, Oct. 28, Nov. 13, I saw a dis-

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* B.A. Report on Meteors, 1872, p. 92.

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play of eleven slow meteors from the point 30°+16°, and in 1879 Oct. 14–20 recorded thirty-seven slow and generally small meteors from a radiant at 31°+9°, or 13° S. of *α Arietis*. Mr. Corder has also observed * many of the shooting stars of the latter shower, which also have been seen by Col. Tupman, notably in 1869, Oct. 13,† from the point 28°+10°. But these showers are probably quite distinct from the Muscids, relatively to which they supply meteors of far inferior magnitude.

I noticed this shower as early as Oct. 8, in 1877, when it furnished a display of eight short, quick meteors. On Oct. 12, 1868, it was splendidly seen by Sig. Zezioli at Bergamo. Twenty-two meteors (six per hour) were traced to a radiant point well-defined to within 1° or 2°, at 53°+27° (Schiaparelli). The latter position, though several degrees E. of the average centre of this shower, undoubtedly represents its very active return in that year. It evidently varies to a considerable degree in different years; for though at about the middle of October 1879 a large number of meteors were registered at Bristol, this radiant point gave no visible indication of activity.

It seems desirable to summarise the various determinations of the radiant point of this special meteor-stream.

Year.	Epoch.		Radiant. α δ ° °	No. of Meteors.	Observer or Authority.
	Oct.	14–Nov.	46 + 27		Greg and Herschel.
1868		12	53 + 27	22	Schiaparelli and Zezioli.
1872		29–Nov. 13	45 + 26	7	D. (from Italian obs.)
1876		14–15	46 + 26	13	D.
1876–9	Oct.–Nov.		43 + 15	34	Corder.
		,,	41 + 13	13	,,
1877	Oct.	8	47 + 28	8	D.
1877		28–Nov. 13	43 + 22	31	D.
1878		21–22	47 + 27	4	Sawyer.
1879		19	44 + 18	4	,,
		20–31	40 + 21	18	D. (from Foreign obs.)
1879	Nov.	12–14	46 + 21	19	D.
1880		28	40 + 21	8	Weiss.
	Oct.	17–22	40 + 20	9	D. (rad. of fireballs).
		25–Nov. 6	48 + 22	17	,,

Mean of 15 radiants = 44°·6 + 22·3, Oct. 8–Nov. 28.

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* *Monthly Notices*, vol. xl. p. 137. Radiants, Nos. 71, 72, and 73.

† See No. 93 of his Catalogue of Radiant Points.

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My recent investigation of the bright meteors of Oct. 17–22 enabled me to identify many fine Orionids from their recorded paths, but the radiant point of this well-known periodical shower is already sufficiently determined. I also found several bright Gemellids amongst the observations, indicating a radiant at 102°+26°.

The shower in *Hercules* occurring also at the October epoch is, however, comparatively unknown. It is situated at 247°+41°, near η *Herculis*, some 64° N.E. of the Sun's place, and in a region almost devoid of meteoric radiants at this time of the year. My attention was first attracted to this shower in 1876, but I had little more than a suspicion of its existence. I saw nothing of it in the several succeeding years, my observations being invariably directed to the eastern sky where, had any Herculids appeared, they would probably escape identification owing to their great distance from the radiant point.

But on Oct. 26, 1883, at $9^h\ 17^m$, while walking along a dark lane in a northern suburb of this city, I suddenly became aware of a brilliant flash illuminating objects around with startling distinctness, and followed by a more prolonged outburst of light. Immediately looking upwards I saw the nucleus of a large fireball passing close to α *Cephei* near the zenith. As I watched it disappear, it gave two other flashes, and then died out suddenly, leaving a broken streak, the brilliant sections of which marked the points where the succession of outbursts had occurred. The meteor rose upwards, traversing a path, as I roughly estimated it, of 24°, and its motion towards the end consisted of a series of spurts, accompanied with brilliant discharges. The streak became extinct in about four seconds, and soon afterwards the sky was covered with clouds, so that I found it impracticable to maintain a watch for further meteors of the same stream, the radiant point of which must evidently have occupied a position in the W.N.W. sky amongst the stars of *Hercules*.*

On consulting Heis's *Resultate* 43 *Jahren* 1833–1875, *Angestellten Sternschuppen-Beobachtungen*, I find he gives a radiant at

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* Several other fireballs appear to have been noticed by different observers on the same date. Mr. D. Cameron says (*Nature*, Nov. 15, p. 56), "At $2^h\ 50^m$ A.M. on Oct. 26, a large ball of fire, apparently seven inches in diameter, illumined the heavens with great brilliancy as it descended from about midway between the third and fourth stars of *Auriga*." The same journal (Nov. 8, p. 44) states that "on Oct. 26, at about 7 P.M., a splendid meteor was seen in the district of Hernosand, Sweden. A traveller on the road to Ragunda says that he suddenly saw the night lit up as in broad daylight, which was caused by a large meteor appearing, with a blinding white lustre, in the zenith, and travelling very rapidly down to the horizon. When halfway, as it appeared to the observer, between the zenith and the Earth, it suddenly burst, throwing a quantity of sparks in every direction." The extremely vague character of these descriptions renders them almost useless, but the observations are worth referring to as showing the prevalence of fireballs on Oct. 26 of this year. It is much to be regretted that in such cases observers generally omit to give those most essential details—the direction and position of the apparent paths.

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238° + 51° from 19 meteors seen between Oct. 17 and Nov. 14, and this shower from the extreme N.W. region of *Hercules* is probably the same as that from which the recent fireball took its departure. Prof. N. de Konkoly had also suspected the shower from observations at O'Gyalla on Oct. 22, 1872, and derived the centre at 243° + 42°.* The radiant is well supported by several brilliant meteors recorded at the same station on Oct. 22, 1873, though this corroboration does not appear to have been previously mentioned. It is obvious that this particular stream is one which merits close watching in future years, not only because its gives a profusion of brilliant meteors, but also on account of the comparatively isolated situation of the radiant point. Owing to the latter circumstance this shower, if a prominent one, will admit of very ready determination, as its meteors will show a peculiarity of direction as compared with those proceeding from the large number of radiants clustering in the eastern sky. It will be best observed in the early evening hours, before the radiant falls low on the northern horizon.

The following are a few bright meteors belonging to this system of Herculids (Heis F_9):

Year 1800+ and Date.			Mag.	Observed Path				Length.	Observer.
				From		To			
				α	δ	α	δ		
53	Oct.	23	1	8°	+34°	18°	+26°	12	Heis, Münster.
60		17	♃	237	+32	229	+23	11½	„
63		25	♀	41	+41	43	+31	10	„
63		25	♀	41	+48	44	+39	9	„
73		22	1	321·4	+ 7·0	352·6	−16·6	39	Konkoly, O'Gyalla.
73		22	♀	330·4	+18·5	5·8	−10·8	46	„
83		26	? = ½ ☽	288	+56	333	+59	24	Denning, Bristol.

Radiant diffuse near η *Herculis*, 247° + 41°.

The above seems to have furnished large meteors at intervals of about ten years. All those observed appear to have left bright streaks. The reappearance of this shower should be carefully looked for in future years. It is true that at this epoch the Orionids usually monopolise attention, but the radiant in *Orion* does not rise until nearly 9 P.M., so that during the three hours preceding this the observer may be usefully employed in watching the N.W. sky for some indication of the return of this apparently rich shower in *Hercules*.

Bristol: 1883, *Nov.* 8.

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* *Beobachtungen angestellt am Astrophysicalischen Observatorium in O'Gyalla* 1879, p. 70.

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Ephemeris for finding the Positions of the Satellites of Mars, 1883–84. By A. Marth.

The major and minor semi-axes a and b of the apparent ellipses described by the satellites, the longitudes $u-\mathrm{U}$ of the satellites reckoned in their orbits from the points which are in superior conjunction with the centre of the planet, and the angle of position P of the minor axes of the apparent orbits are approximately the following:—

		Phobos.				*Deimos.*				
Greenw. Noon. 1883.		a_1	b_1	$u_1-\mathrm{U}$	Diff. 2250° +	P	a_2	b_2	$u_2-\mathrm{U}$	Diff. 570° +
		″	″	°	°	°	″	″	″	°
Dec.	19	15·38	+4·93	36·05	7·68	4·56	38·42	+12·32	271·99	0·25
	21	15·64	5·00	133·73	·73	4 62	39·06	12·49	122·24	·30
	23	15·90	5·06	231·46	·78	4·65	39·71	12 65	332·54	·36
	25	16·16	5·12	329·24	·84	4·65	40·36	12·79	182·90	·41
	27	16·42	5·18	67·08	·89	4·61	41·01	12·93	33·31	·47
	29	16·68	5·23	164·97	·93	4·54	41·65	13·06	243·78	·52
	31	16·93	5·27	262·90	7·99	4·43	42·29	13·17	94·30	·57
1884. Jan.	2	17·18	+5·31	0·89	8·05	4·29	42·92	+13·26	304·87	0·63
	4	17·43	5·34	98·94	·09	4·12	43·54	13·34	155·50	·68
	6	17·67	5·36	197·03	·14	3·91	44·14	13 40	6·18	·74
	8	17·90	5·38	295·17	·19	3·67	44·72	13·44	216·92	·78
	10	18·12	5·39	33·36	·24	3·40	45·27	13·47	67·70	·83
	12	18·33	+5·39	131 60	8·28	3·09	45·79	+13·47	278·53	·88
	14	18·53	5·38	229·88	·32	2·75	46·28	13·45	129·41	·93
	16	18·71	5·37	328·20	·35	2·39	46·73	13·40	340·34	0·96
	18	18·87	5·34	66·55	·39	2·00	47·13	13·33	191·30	1·00
	20	19·01	5·30	164·94	·41	1·59	47·48	13·24	42·30	·03
	22	19·13	+5·26	263·35	8·44	1·15	47·77	+13·13	253·33	·06
	24	19·22	5·20	1·79	·45	0·69	48·01	12·99	104·39	·08
	26	19·29	5·14	100·24	·47	0·21	48·19	12·83	315·47	·10
	28	19·34	5·07	198·71	·47	359 73	48·31	12·66	166·57	·10
	30	19·36	4·99	297·18	·47	359·23	48·36	12·46	17·67	·11
Feb.	1	19·35	+4·90	35·65	·46	358·73	48·34	+12·25	228·78	·10
	3	19·32	4·81	134·11	·45	358·23	48·26	12·02	79·88	·10
	5	19·26	4·72	232·56	·43	357·74	48·11	11·79	290·98	·08
	7	19·18	4·62	330·99	·40	357·25	47·90	11·55	141·06	·06
	9	19·07	4·52	69·39	·37	356·77	47·63	11·30	353·12	·04